Appendix E
NATURAL RESOURCES

FACTORS AFFECTING WETLANDS

Factors, which influence wetland systems, include hydrology, fire, geology and soils, climate, and ecological succession. This section presents an overview of each of these factors.

Hydrology

Hydrology is the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes (Mitsch and Gosselink, 1986). Hydraulic inflows and outflows, such as precipitation, surface runoff, ground water inputs, and in some cases, tides and river flooding, provide the energy to transport nutrients and other organic material to and from wetlands. Water depth, hydroperiod, flow patterns, stage, duration, frequency of flooding, and water quality all influence the biochemistry of wetlands and ultimately, the species composition and type of wetland community that develops. The hydrology of a wetland acts both as a limit and a stimulus for determining the numbers and types (species) of flora and fauna that can live within or utilize a specific wetland. Hydrology also strongly affects aquatic primary production, organic accumulation, and the cycling of nutrients (Mitsch and Gosselink, 1986).

Precipitation

The Kissimmee Basin (KB) Planning Area experiences wide variations in annual rainfall, resulting in both flooding and extended drought periods. During heavy rainfall years, there is overland flow and discharge to the many lakes in the area and to the Kissimmee River, which ultimately discharges into Lake Okeechobee. During extended drought years, however, the natural system is stressed by decreased spring flow, increased frequency of fires, loss of organic soils, and invasion of wetlands by exotics.

Evapotranspiration

Evapotranspiration (ET) is the combined process of evaporation from land and water surfaces, and from plants. ET rates vary as a function of solar radiation, air and water temperature, relative humidity, wind velocity and duration and the type and density of vegetation (Duever et al., 1986). In South Florida, ET ranges from 70 to 95 percent of annual rainfall. During the dry season and drought years, ET exceeds rainfall inputs (Klein et al., 1975). Temperature is often regarded as the most important factor controlling ET. Minimum ET rates occur during the winter months of December and January, with highest values experienced during the spring months of April and May. Typical ET values for South Florida range from 40 to 45 inches a year, up to a maximum of 60 inches a year (Parker et al., 1955). ET rates frequently account for virtually all water losses in a wetland because of their slow rate of flow and high surface area to depth ratio (Mitsch et al., 1988). As a result, ET plays a very important role in the development of any hydrologic model that might be developed for a particular wetland system and is usually the most difficult parameter to estimate. Wetlands have higher ET rates than other habitats largely because

they store water at or near the ground surface where it can be lost to the atmosphere (Duever, 1988).

Hydroperiod

Hydroperiod refers to the annual period of water level inundation, specifically the depth and length of time (duration) that a wetland contains water above ground level. **Figure E-1** presents examples of typical hydroperiods experienced by three different South Florida plant communities. Duever et al. (1986) reports that hydroperiod is the dominant factor controlling both the existence, plant community composition and succession of South Florida wetland systems. Hydroperiod is often expressed in terms of the range of the number of days that a wetland is normally inundated. Each wetland type is thought to have a hydrologic signature that describes the rise and fall of water levels from year to year (Mitsch and Gosselink, 1986). In contrast, O'Brian and Ward (1980) state that from a hydrological point of view, the most significant feature of a wetland is the level of the ground water table. They point out that the depth to the ground water table is more significant than the hydroperiod or time the wetland is flooded.

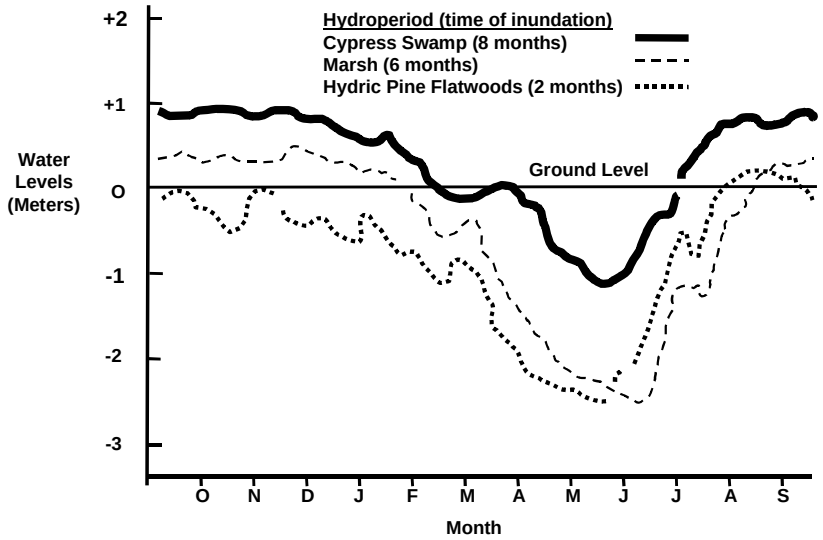

Figure E-1. Hydrographs and Hydroperiod Ranges for Three Different South Florida Vegetation Types (From Duever et al., 1986).

Water Level Depth and Timing

In South Florida's freshwater wetlands, wading bird nesting success is highly dependent on present and past water level conditions, which influence the amount and availability of wading bird prey items, such as crayfish and small forage fish (Kushlan, 1976, 1978, 1979, 1980, 1986; Powell, 1987. Kahl (1964) found that the timing and

initiation of wood stork breeding attempts was predictable from the measurement of marsh surface water levels. Kushlan et al. (1975) found that wading bird nesting success was directly related to the rapid winter/spring recession of water levels (drying rate) of South Florida wetlands. Therefore, maintenance of appropriate water depths and timing of wetland water level fluctuations is a critical factor in determining wading bird nesting success.

Topography

In general, wetlands in temperate and tropical regions tend to develop in areas of low topographic relief and high rainfall inputs. Topography also controls the shape and size of watersheds, and affects the timing and quantity of runoff. Topography is also an important factor in controlling the vertical and horizontal extent of seasonal water level fluctuations within a wetland. At the site-specific level, wetlands are determined by the depth and duration of inundation, which in turn are influenced by site micro topography (differences in water depth of only a few centimeters), soil type, and vegetative cover (Duever et al., 1986).

Vegetation Type

Vegetation type can affect the hydrologic cycle of a wetland, primarily through ET. Vegetation also influences water movement and water quality. Plant leaves, leaf litter, and attached periphyton (algae) communities tend to impede water flow which: (1) increases the period of inundation, (2) reduces surface water runoff and erosion, (3) allows more time for aquifer recharge, and (4) assimilates nutrients and chemical exchanges between the soil vegetation and water (Duever et al., 1986).

Tropical Storms and Hurricanes

Hurricanes, tropical storms that generate winds in excess of 75 miles per hour, are recurrent events in South Florida and are important physical processes that affect the regional ecology (Craighead and Gilbert, 1962). Hurricanes normally cause the greatest amount of damage when wind velocities average greater than 111 miles per hour. They also have the potential of producing massive quantities of precipitation in a very short period of time.

Fire

Fire is also an important factor controlling the species composition, distribution, and succession of wetland communities in the KB Planning Area. Within the constraints of wetland hydrology, fires occur with variable frequency and severity affecting plant succession.

Theoretically, hardwood hammocks represent the climax plant community for South Florida (Alexander and Crook, 1973; Wharton et al., 1977; Duever, 1984).

Hammocks develop when fire is absent or infrequent, and organic soils are allowed to build up over time to support the succession of hardwoods. However, fire is a common component of the South Florida landscape.

Ewel and Mitsch (1978) investigated the effects of fire on a cypress dome in Florida. They found that fire had a cleansing effect on the dome, selectively killing almost all of the pines and hardwoods and yet killing relatively few pond cypress, suggesting a possible advantage of fire to some shallow cypress ecosystems in eliminating competition that is less water tolerant (Mitsch and Gosselink 1986).

Geology and Soils

Two primary factors which affect the hydrogeology of wetlands are the porosity and permeability of its underlying soils (Duever, 1988). A highly porous soil can hold or store large amounts of water, while a highly permeable soil allows water to flow to the underlying aquifer. The high capillary action of peat or clay soils enable wetlands to store large quantities of water, somewhat similar to how a sponge takes up water.

Some wetlands contain perched water tables. A perched water table exists where a saturated soil layer is found above a water table and is separated from it by an unsaturated zone (Freeze and Cherry, 1979). This can occur where a relatively impermeable clay or organic soil layer is present near the ground level and restricts the downward movement of water. Perched water tables come in various sizes and can influence surface water levels over large areas or have only local, temporary effects (Duever, 1988). A common misconception is that wetlands can only occur on sites containing a perched water table.

Climate

In addition to hydrology and fire, climate also plays an important role in controlling plant community succession. The areal extent, species composition, and existence of wetlands are all affected by long-term climatic changes. In addition to normal cyclic drought and flood conditions, long-term cycles have the ability to produce gradual, and nevertheless, major shifts in the normal year-to-year range of hydrologic conditions. As climatic cycles become wetter, wetlands will tend to cover larger areas of the landscape. Wetland communities would also tend to become more diverse as a result of the presence of greater ranges of hydroperiods on different topographic sites. A wetter climate might also increase the rate of peat accretion in wetlands, thus encouraging the development of edaphic plant communities. Long-term drier conditions might produce the opposite effects. A wetter or dryer climate might also affect the frequency of fire, shifting plant community succession. A major difficulty in managing wetlands is our inability to distinguish between shifts in hydrologic conditions that result from man’s activities and those that result from occasional natural events or long-term shifts in climate (Duever, 1984).

Succession

Over drainage of wetlands and reduction of hydroperiod length influences the direction of plant community succession within a wetland. McPhearson (1973) reported that “differences of only a few inches in depth or changes in period of inundation will determine, in time, what plant communities are present [in the Everglades].” Numerous investigators have documented changes in the species composition of South Florida plant communities resulting from altered water level conditions (Davis, 1943; Loveless, 1959; Kolipinski and Higer, 1969; Dineen, 1972, 1974; Alexander and Crook, 1973, 1988; Schortemeyer, 1980; Worth, 1983). The successional relationships of South Florida wetland and upland plant communities have been discussed by Alexander and Crook (1973), Craighead (1971), Davis, (1943), Wharton et al. (1977), and Duever, et al. (1986). This successional relationship is presented in **Figure E-2**. These data are useful for making a general assessment of the direction that succession may take as a result of increasing or decreasing hydroperiod in a Florida wetland.

THREATENED, ENDANGERED, AND SPECIES OF SPECIAL CONCERN

Loss of habitat and habitat fragmentation are the major causes of the decline in a number of listed rare, threatened, or endangered (RTE) wildlife species in South Florida. Reduction in population is due largely to conversion of natural habitats to agricultural and urban uses. Some species, such as the Florida panther and black bear, require large expanses of land to successfully survive as a breeding population. Other species are restricted to one particular type of habitat, such as the Florida scrub jay (pine/oak scrub) or red-cockaded woodpecker (mature pine flatwoods). Listed RTE species within the KB Planning Area depend on both wetland and upland communities for survival. For example, the Florida panther inhabits uplands, but it frequents wetlands. The reverse is true for other species, such as the wood stork.

Agricultural and urban development have gradually fragmented and reduced the quality and size of existing wildlife habitat. Continued fragmentation of upland and wetland ecosystems has the potential to cause problems for the survivorship of many species. **Table E-1** presents a list of the rare, threatened, and endangered species and species of special concern that are found within the KB Planning Area. The following is a summary of selected species listed in the table.

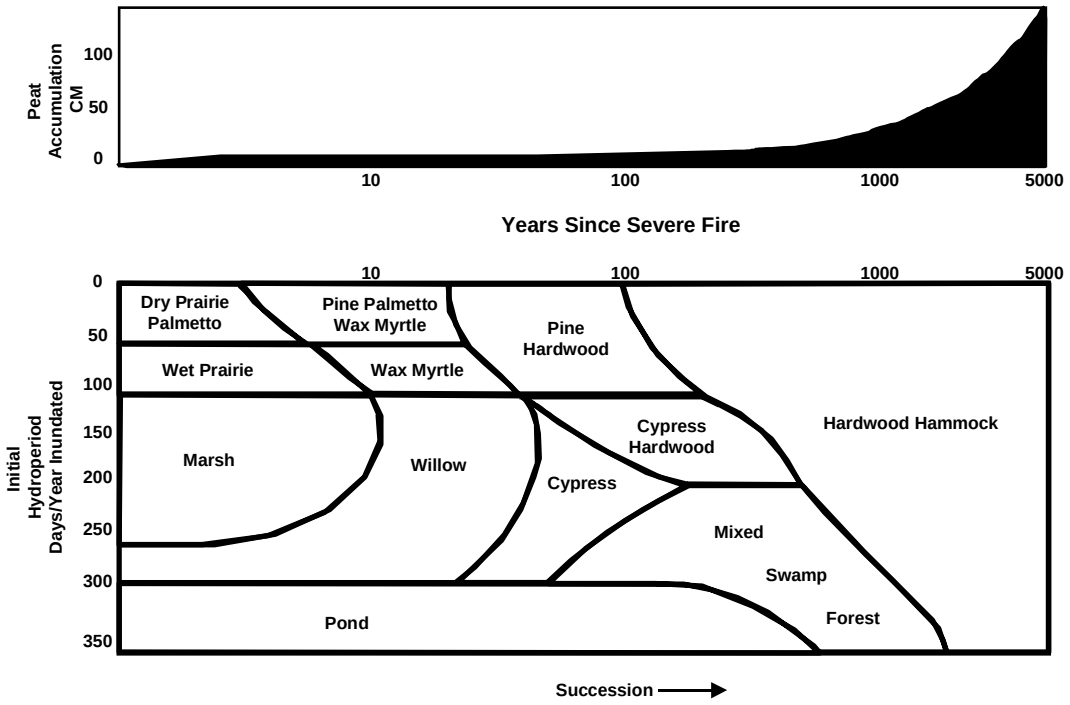

Figure E-2. Successional Patterns and Rates within South Florida Inland Plant Communities (after Duever, 1976).

Table E-1. Threatened, Endangered, and Species of Special Concern, by County.

Species	County	Species Designation by Agency		
		FWC	FDA	USFWS
Mammals Florida Black Bear *Ursus americanus floridanus*	G, H, Or, Os, P	T		C2
Florida Mouse *Podomys floridanus*	H, Or, Os, P	SSC		C2
Florida Panther *Felis concolor coryi*	G, H	E		E
Round-tailed Muskrat *Neofiber alleni*	G, H, Ok, Or, Os, P			C2
Sherman's Fox Squirrel *Sciurus niger shermani*	G, H, Ok, Or, Os, P	SSC		C2
Southeastern Big Eared Bat *Plecotus rafinesquii*	H, Ok, Or, Os, P			C2
West Indian Manatee *Trichechus manatus*	G, Ok	E		E
Birds Bachman's Sparrow *Aimophila aestivalis*	G, H, Ok, Or, Os, P			C2
Bald Eagle *Haliaeets leucocephalus*	G, H, Ok, Or, Os, P	T		E
Black Rail *Laterallus jamaicensis*	Ok, Os, Or			C2
Crested Caracara *Polyborus plancus audubonii*	G, H, Ok, Os, P	T		T
Florida Grasshopper Sparrow *Ammodromus savannarum floridanus*	G, H, Ok, Os, P	E		E
Florida Sandhill Crane *Grus canadensis pratensis*	G, H, Ok, Or, Os, P	T		
Florida Scrub Jay *Aphelocoma coerolescens coerulescens*	G, H, Ok, Or, Os, P	T		T
Least Tern *Sterna antillarum*	H, Ok, Or	T		
Limpkin *Aramus guarauna*	G, H, Ok, Or, Os, P	SSC		
Little Blue Heron *Egretta caerulea*	G, H, Ok, Or, Os, P	SSC		
Peregrine Falcon *Falco peregrinus*	G, H, Ok, Or, Os, P	E		T
Red Cockaded Woodpecker *Picoides borealis*	G, H, Or, Os, P	T		E
Snail Kite *Rostrhamus sociabilis plumbeus*	G	E		E
Snowy Egret *Egretta thula*	G, H, Ok, Or, Os, P	SSC		

Table E-1. (Continued) Threatened, Endangered, and Species of Special Concern, by County.

Species	County	Species Designation by Agency		
		FWC	FDA	USFWS
Southeastern American Kestrel *Falco sparverius paulus*	G, H, Ok, O, Os, P	T		C2
Tricolor Heron *Egretta tricolor*	G, H, Ok, Or, Os, P	SSC		
Wood Stork *Mycteria americana*	G, H, Ok, Or, Os, P	E		E
Reptiles American Alligator *Alligator mississippiensis*	G, H, Ok, Or, Os, P	SSC		T(S/A)
Blue-tailed Mole Skink *Eumeces egregius lividus*	H, P	T		T
Eastern Indigo Snake *Drymarchon corais couperi*	G, H, Ok, Or, Os, P	T		T
Florida Pine Snake *Pituophis melandeucus mugitus*	H, Or, P	SSC		C2
Florida Scrub Lizard *Scelaporus woodi*	H, Or, Os, P			C2
Gopher Tortoise *Gopherus polyphemus*	G, H, Ok, Or, Os, P	SSC		C2
Sand Skink *Neoseps reynoldsi*	H, Or, Os, P	T		T
Short Tailed Snake *Stilosoma extenuatum*	H, Or, P	T		C2
Suwannee Cooter *Pseudemys concinna suwanniensis*	P	SSC		
Amphibians Gopher Frog *Rana areolata aesopus*	H, G, Or, Os, P	SSC		C2
Fish Lake Eustis Pupfish *Cyprinodon variegatus hubbsi*	Or	SSC		
Plants Ashe's Savory *Calamintha ashei*	H, Or, P		T	C1
Auricled Spleenwort *Asplenium auritum*	H		E	
Avon Park Rabbit Bells *Crotalaria avonensis*	H		E	
Banded Wild-pine *Tillandsia flexuosa*	H		T	
Beautiful Paw Paw *Deeringothamnus pulchellus*	Or		E	E
Britton's Bear Grass *Nolina brittoniana*	H, Or, Os, P		E	E
Carter's Warea *Warea carteri*	H, P		E	E

Table E-1. (Continued) Threatened, Endangered, and Species of Special Concern, by County.

Species	County	Species Designation by Agency		
		FWC	FDA	USFWS
Chaffseed *Schwalbea americana*	H		E	E
Clasping Warea *Warea amplexifolia*	Or, Os, P		E	E
Craighead's NoddinF-Caps *Triphora craigheadii*	H		T	C2
Curtiss' Milkweed *Asclepias curtissii*	H, Or, Os, P		E	
Cutthroat Grass *Panicum abscissum*	H, Os, P		T	C2
Edison's Ascyrum *Hypericum edisonianum*	H, G		T	C2
Fall Flowering Ixia *Nemastylis floridana*	Ok, Or, Os		E	C2
Florida Bear Grass *Nolina atopocarpa*	Or		E	C2
Florida Bonamia *Bonamia grandiflora*	H, Or, Os, P		E	T
Florida Gay Feather *Liatris ohlingerae*	H, P		E	E
Florida Jujube *Ziziphus celata*	H, P		E	E
Florida Lantana *Lantana depressa*	H, P			C2
Florida Spiny Pod *Matelea floridana*	Or		E	C2
Florida Willow *Salix floridana*	Or		T	C2
Gulf Spikemass *Selaginella ludoviciana*	H, D		T	
Garrett's Scrub Balm *Dicerandra christmanii*	H		E	
Hairy Jointweed *Polygonella basiramia*	H		E	E
Hand Fern *Ophioglossum palmatum*	Or, P		E	
Hartwrightia *Hartwrightia floridana*	H, P		T	C2
Highlands Scrub Hypericum *Hypericum cumulicola*	H, P		E	E
Incised Groove-Bur *Agrimonia incisa*	P			C2
Large Flowered Rosemary *Conradina grandiflora*	Or, Os		E	C2

Table E-1. (Continued) Threatened, Endangered, and Species of Special Concern, by County.

Species	County	Species Designation by Agency		
		FWC	FDA	USFWS
Lewton's Polygala *Polygala lewtonii*	H, Or, Os, P		E	E
Lowland Loosestrife *Lythrum flagellare*	G, Ok, Os			C2
Meadow Spikemoss *Selaginella apoda*	Os, P		T	
Night Scented Orchid *Epidendrum nocturnum*	Ok		T	
Nodding Pinweed *Lechea cernua*	H, Os, P		E	C2
Okeechobee Gourd *Cucurbita okeechobeensis*	G		E	E
Paper-Like Nail-Wort *Paronychia chartacca*	Or, P		E	T
Perforate Cladonia (lichen) *Cladonia perforata*	H			E
Piedmont Jointgrass *Coelorachis tuberculosa*	H, Or			C2
Piedmont Water-Milfoil *Myriophyllum laxum*	Os			C2
Pigeon Wing *Clitoria fragrans*	H		T	T
Pigmy Fringe-Tree *Chionanthus pygmaeus*	H, Os, P		E	E
Pine Pinweed *Lechea divaricata*	H		E	C2
Pinesap *Monotropa hypopithys*	Or		E	
Rain Lily *Zephyranthes simpsonii*	G, H, Ok, Os, P		E	
Sand-Dune Spurge *Chamaesyce cumulicola*	H			C2
Scrub Bluestem *Schizachyrium niveum*	H, P			C2
Scrub Buckwheat *Eriogonum longifolium var gnaphalifolium*	H, Or, Os, P		T	T
Scrub Lupine *Lupinus aridorum*	Or, P		E	E
Scrub Mint *Dicerandra frutescens*	H, P		E	E
Scrub Plum *Prunus geniculata*	P		E	E
Short-Leaved Rosemary *Conradina brevifolia*	H, P		E	

Table E-1. (Continued) Threatened, Endangered, and Species of Special Concern, by County.

Species	County	Species Designation by Agency		
		FWC	FDA	USFWS
Small's Jointweed *Polygonella myriophylla*	H, Or, Os, P		E	
Southern Maidenhair Fern *Adiantum capillus-veneris*	H		T	
Southern Red-lily *Lilium catesbaei*	H, Ok, Os, P		T	
Spoon-Leaved Sundew *Drosera intermedia*	H		T	
Star Anise *Illicium parviflorum*	Or, P		T	C2
Terrestrial Peperomia (Pepper) *Peperomia humilis*	Or		E	
Wedge-Leaved Button-Snakeroot *Eryngium cuneifolium*	H, P		E	E
Wild Coco *Pteroglossaspis ecristata*	H		T	C2
Yellow Fringeless Orchid *Platanthera integrilabia*	Or, Os		T	C2

County: G = Glades; H = Highlands; Ok = Okeechobee; Or = Orange; Os = Osceola; P = Polk.

Species Designations: E = Endangered; T = Threatened; SSC = Species of Special Concern.

C1 = A candidate for federal listing for which there is enough substantial information on biological vulnerability and threats to justify listing.

C2 = A candidate for federal listing with some evidence of vulnerability, but for which not enough information exists to justify listing.

C1 and C2 species are not federally protected under the Endangered Species Act, but the USFWS “encourages their consideration in environmental planning” (US FR Vol. 55, No. 35, pp. 6184-6229).

Agencies: FWC = Florida Wildlife Commission - Jurisdiction over Florida’s animals (vertebrates and invertebrates); FDA = Florida Department of Agriculture and Consumer Services - Jurisdiction over Florida’s plants; USFWS = United States Fish and Wildlife Service - Jurisdiction over nation’s plants and animals.

Source: The Nature Conservancy, 1990 and Florida Game and Fresh Water Fish Commission, 1994.

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